Sediment Sampling Plan

An investigation of sediment characteristics will be conducted, as part of the feasibility level study of decommissioning the four lower dams on the Klamath River. Sediment characteristics will provide information regarding the spatial distribution of sediment particles and chemistry of sediment particles trapped in the reservoirs.

Objective

The objective of sediment sampling is to collect sufficient sediment samples to accurately characterize the physical and chemical properties of the sediment trapped in the reservoirs. The objective of the activities in this initial round of testing is to provide preliminary information regarding sediment characteristics. The information developed will be used as a basis for analysis of sediment management approaches relating to the assessment of the feasibility of decommissioning and removing the four lower Klamath River Dams.

Sample results will provide information that will help determine the behavior and impacts of sediment released from the reservoirs following dam removal. PacifiCorp, the project owner, conducted very preliminary sediment volume and size analysis in previous work. That sediment size analysis did not include physical testing of sediment samples for grain size characteristics or chemical constituents. Sampling conducted in this process will provide sufficient information regarding the size and location of sediment particles to allow analysis of sediment erosion and deposition behavior, as the dams are demolished. Chemical analysis will help assess the feasibility of releasing sediment through erosion by identifying possible contamination and determining if further testing is necessary.

Methodology

Hydroelectric dam decommissioning activities can result in the release of large quantities of natural river sediments. No codified method of determining the suitability of release of these sediments has been established. The proposed method of evaluating the characteristics of the released sediment involves reviewing the watershed conditions that contribute sediment to the reservoirs and sediment sampling and testing activities.

The first phase of the process involves an analysis of potential sources of contamination in the watershed The Phase 1 study, entitled Upland Contaminant Source Study conducted by Shannon and Wilson, Inc. (Upland Study) is similar to a Puget Sound Dredged Disposal Analysis (PSDDA) Tier 1 analysis. This phase was conducted to identify general and specific potential sources of contamination to help guide decisions regarding testing for specific chemicals and use of testing methods.

Two methodologies for sediment testing were reviewed and considered. Both address issues similar to those involved in this decommissioning study. Both test are similar. The method not selected is presented in the Inland Testing Manual, developed jointly by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency to

assess dredged material. Guidelines used are those developed to implement the Clean Water Act. These guidelines and associated screening levels are those adopted for use in the Dredge Material Evaluation Framework for the Lower Columbia River Management Area, November 1998 (DMEF).

Another similar set of sediment testing protocols used in protocols Washington State's Puget Sound region are the Puget Sound Dredged Disposal Analysis (PSDDA) guidelines. These sediment testing guidelines have been established for deposition of dredged materials in the marine environment within the Sound and have been in use since the 1980's. PSDDA guidelines have been used to perform sediment analysis on similar decommissioning projects including the Elwha River Restoration project, The Matilija Dam Removal project, and the Condit Dam Removal Project

PSDDA involves several related levels (Tiers) of testing. Tier 2 laboratory testing is guided by the Tier 1 results (Upland Study). Tier 2 PSDDA analysis involves laboratory chemical tests on samples extracted from sediment.

The objective of the PSDDA sampling and testing activities is to determine whether dredged materials are suitable for deposition in marine environments without adverse impacts from the dredged materials. Since the PSDDA protocols were used so extensively on dredging projects and other dam decommissioning projects they were chosen for this project.

The PSDDA methodology sets screening levels for contaminant concentrations. Test results below screening levels indicate that the sediment contamination can be ranked as low and contamination is not significant. Concentrations of contaminants above screening levels require further sediment testing.

Sample Collection

To collect samples a geotechnical engineering firm will supervise a drilling contractor as the contractor drills into the sediment at 25 over the water locations and collects samples from Iron Gate, Copco I, Copco II, and J. C. Boyle reservoirs. Sediment samples will be taken from cores 3 inches in diameter at intervals of 30 inches No fewer than 40 select sediment samples shall be taken for the purpose of physical and chemical testing.

The total number of samples will be based on conditions encountered during sample drilling and retrieval activities. The number of drill sites in each reservoir is based on the relative volume of sediment in each reservoir. Current estimates of sediment volume in the three reservoirs will be used to distribute the location of the samples. Sediment depth has been analyzed using predam topographic survey information compared to bathymetric survey work conducted by PacifiCorp in 2003. Current estimates of sediment volume are shown in Table 1.

Table 1 Sediment Volume and Sampling Sites

Reservoir	Volume Cubic Yards	Number of Drill Sites
Iron Gate Reservoir	8,860,000	9
Copco 2 Reservoir	<200,000	1 Grab Samples
Copco 1 Reservoir	11,000,000	11
J. C. Boyle Reservoir	1,000,000	5 Grab Samples

PSDDA sampling frequency criteria is based on the suspected degree of sediment contamination and volume of sediment to be dredged. PSDDA procedures provide two levels of sediment characterization, full and partial characterization. Full characterization is usually conducted on sediment of known high contamination levels. The frequency of testing is based on contamination level and volume of sediment.

Because this investigation is a feasibility level analysis and not an attempt to conduct a final characterization for sediment disposal, and because the Upland Study suggests that the sediment is not suspected to be highly contaminated, PSDDA testing frequency guidelines as designated for full characterization were not used. Partial characterization does not specify exact frequency of testing. Sediment sampling frequency will be adequate for feasibility level analysis.

Several issues were considered when determining testing sites, including 1) the volume and thickness of sediment in a sediment sample area, 2) possible sources of upland contamination, and 3) the history of the particular reservoir.

Copco 1 reservoir was constructed in 1918 at approximately the same time as the Link River dam (1920). Therefore, most sediment traveling downstream between Link River and Copco 1 deposited in Copco 1 reservoir before 1959 when Big Bend Dam (now J. C. Boyle dam) was built. Consequently, the largest number of samples will be taken in Copco 1 since it has the largest volume of sediment retained in it and has the highest historical exposure to possible contaminants, especially those from upstream agricultural activities.

Analysis

Analysis will be conducted on the standard suite of PSDDA analytes with the exception of Tributyltins, which are specifically associated with painting marine vessels. Since this type of activity would not be expected in the watershed this test is not considered to be appropriate. The list of chemicals to be tested is provided in Table 2

While dioxins are not included in the standard list of chemicals, PSDDA requires testing for dioxins if a paper mill is in close proximity to the tested material. No paper mills were found within 20 miles of the reservoirs.

Furthermore, though toxic, dioxins are ubiquitous in the environment. Dioxins are formed as a result of combustion processes such as commercial or municipal waste incineration and from burning fuels (such as wood, coal or oil), can also be formed when household trash is burned, and as a result of natural processes such as forest fires. Chlorine bleaching of pulp and paper, certain types of chemical manufacturing and processing, and other industrial processes all can create small quantities of dioxins.

Screening levels for dioxins are extremely low so dioxins from sources other than paper mills would most likely show in chemical tests. Because no mills were found in the vicinity of the reservoirs and testing would not be likely to add information to our knowledge of the sediment contamination, dioxins were not included in the proposed suite of tests.

Samples will be taken at 2 ½ foot intervals. These samples will be inspected on site for variation between samples. Any sample that appears unusual or displays a reason for suspecting a high probability of contamination to the geotechnical engineer on site will tested separately. Otherwise, all material in a bore hole less than 15 feet deep will be mixed together (composited) and tested. Holes deeper than 15 feet will be split equally into two samples and each sample will be tested separately. This procedure should result in testing of approximately 26 samples.

EPA Region 9 uses PSDDA procedures as guidelines for dredging activities in that region since specific guidelines have not been established for the region. This type of testing, performed after Tier 1 evaluation but not to full characterization guidelines, is termed confirmatory testing by Region 9 personnel. It is not intended to establish the exact location of specific contaminants but to confirm the results of the Tier 1 analysis.

Table 2 RECOMMENDED ANALYSES

Parameter for All Samples	
Grain size distribution	
Parameters for Frequent Samples	**Parameters for Selected (Infrequent) Samples**
Percent solids	Organochlorine pesticides:
Total volatile solids (TVS)	Total DDTs (p,p) Gamma-HCH (lindane) Heptachlor Chlorpyrifos (Lorsban) Alpha-Chlordane Iprodione (Rovral) Aldrin PCNB (Blocker) Dieldrin & Others
Total organic carbon (TOC)	
Total sulfides	
Acid volatile sulfides	Organophosphorus pesticides:
pH	Dimethoate Ronnel Diazinon Parathion – Methyl Atrazine Malathion Simazine & Others
Calcium carbonate	
Ammonia	Chlorinated acid herbicides
PCBs	
Metals: Antimony Manganese Arsenic Mercury Cadmium Nickel Chromium Selenium Copper Silver Lead Zinc	Volatile Organic Compounds (VOCs): Trichloroethene (TCE) 1,1-Dichloroethene Tetrachloroethene (PCE) Vinyl chloride Ethylbenzene Toluene Total xylenes Trans-1,2-dichloroethylene Benzene 1,1,1-Trichloroethane (1,1,1-TCA) MTBE Chloroform
	Semivolatile Organic Compounds (SVOCs):* Phenols Low molecular weight aromatic hydrocarbons (LPAH) High molecular weight aromatic hydrocarbons (HPAH) Chlorinated aromatic hydrocarbons Chlorinated aliphatic hydrocarbons Phthalate esters Miscellaneous oxygenated compounds Organonitrogen compounds

Upland Contaminant Source Study Results

A upland study, similar to a PSDDA Tier 1 study, was conducted to better understand potential contaminant sources and help inform the frequency and location of sediment sampling. The results of the study suggest that PSDDA sampling protocols would be appropriate for detection of possible contaminants in the watershed. The study also found that in addition to the PSDDA suite of analytes, guaiacols should also be investigated. Figure 1 shows the results for potential point source contaminants found in the study. The study also found that land in the watershed had been used for agriculture, forestry, wood products manufacturing, and transportation of products by railroads. No major mining activities were found in the watershed area.

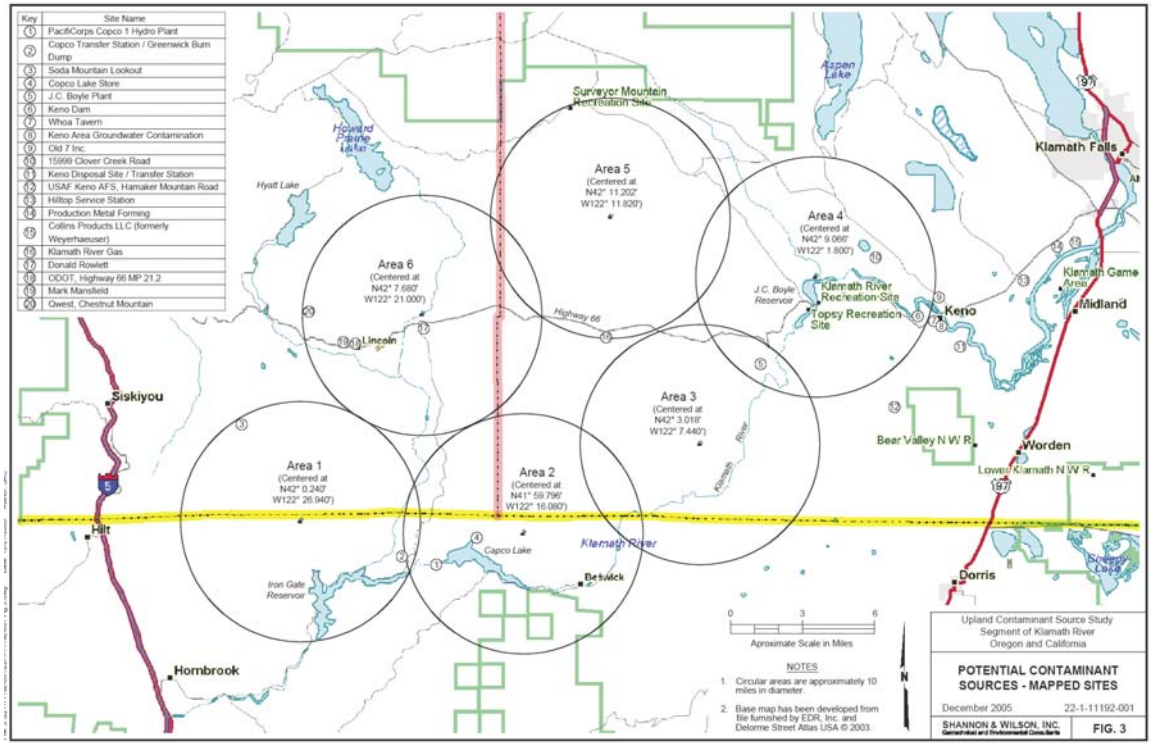


Figure 1 Potential Contaminant Point Source Sites

OTHER UPSTREAM POTENTIAL CONTAMINANT SOURCES

Site Name and Address	Closest EDR Area	Fig. 3 ID	List(s)	Notes	Potential Contaminants	Relevant Sediment Analyses/EPA Method
Keno Disposal Site/ Transfer Station, OR	Area 4, orphan	11	ECSI	Added to database for tracking as a former solid waste disposal site.	TPH Metals Pesticides	SVOCs/8270C/SIM Metals/6010/7471 Pesticides/8081
Whoa Tavern and Keno Area Groundwater Contamination, OR	Area 4, orphans	7, 8	ECSI, LUST	**Benzene** in well water up to 350 µg/L; **MTBE** in Keno Elementary School drinking water up to 185 µg/L. Five wellhead treatment systems installed. Klamath River about 500 feet northeast.	VOCs	VOCs/8260
USAF Keno AFS Peak end of Hamaker Mountain Road, OR	Areas 3 and 4, orphan	12	LUST, CERC-NFRAP, RCRA-SQG	**Diesel** in soil discovered in soil during UST decommissioning; cleanup completed.	TPH	SVOCs/8270C/SIM
Collins Products, LLC (formerly Weyerhaeuser) 6410 Highway 66, Klamath Falls, OR	Area 4, orphan	15	LUST, ECSI, UST, OR HAZMAT	Sawmill, planing, pressed-wood plant. Areas of concern: 1) old landfill, 2) **storm-water outfall**, 3) sawmill and powerhouse, and 4) **sediment**. Contaminants detected at 1) include **metals** (lead, chromium, manganese, nickel, copper, selenium, and zinc) in soil and GW. **Oily sheen has been**	TPH, PAHs Metals VOCs	SVOCs/8270C/SIM Metals/6010/7471 VOCs/8260

Site Name and Address	Closest EDR Area	Fig. 3 ID	List(s)	Notes	Potential Contaminants	Relevant Sediment Analyses/EPA Method
				observed on 2). At 3), soil samples from TPs had TPH concen-trations up to 26,400 mg/kg; **free product on groundwater**; some soil removed, but confirmation samples showed **chromium** in soil between residential and industrial PRGs. Six MWs sampled/tested in 1995 for VOCs, SVOCs, and metals; **1,1-dichloroethene, TCE, PCE, vinyl chloride, Bis(2-ethyl-hexyl)phthalate,** and **arsenic** exceeded PRGs. 4) **sediments** sampled in 1995 and 1996: **bioassays indicated toxic effects**. Samples analyzed for TPH, SVOCs, and metals; all had **TPH** greater than 500 ppm. **Arsenic, chromium, copper, mercury, total PAHs,** and four individual **PAHs** exceeded PSQG.		
Unocal Bulk Plant	Area 4, DEQ		ESCI, LUST	Cleanup in progress;	TPH	SVOCs/8270C/SIM

Site Name and Address	Closest EDR Area	Fig. 3 ID	List(s)	Notes	Potential Contaminants	Relevant Sediment Analyses/EPA Method
Plant 1459 S 6th Street, Klamath Falls, OR	Profiler		LUST	contaminated GW (**benzene** 2,300 mg/L and **ethylbenzene** 1,200 mg/L) soil **TPH** up to 28,000 mg/kg.	VOCs	VOCs/8260
Columbia Plywood Corp., Hwy 97 South, Klamath Falls, OR	Area 4, orphan		ECSI, LUST	2002 compliance audit (DEQ) noted two surface spills; **hydraulic fluid** likely to enter Klamath River (located within 20 feet of river). 2003 sampling indicated GW collected immediately adjacent to the river had **toluene** and several **PAHs** exceeding ecological risk screening levels. Heating oil LUST; cleanup completed.	TPH, PAHs VOCs	SVOCs/8270C/SIM VOCs/8260
Hilltop Service Station, 14413 Highway 66, Klamath Falls, OR	Area 4, DEQ Profiler	13	LUST	Gasoline release to soil discovered during tank decommissioning; cleanup completed.	TPH Lead	SVOCs/8270C/SIM Lead/6010
Production Metal Forming 8888 Highway 66, Klamath Falls, OR	Area 4, DEQ Profiler	14	HW Gen	Waste material: spent acid with metals.	Metals	Metals/6010/7471
Union Pacific Railroad Co. 1585 Oak Ave., Klamath	Area 4, DEQ Profiler		ECSI	**Diesel** spill (about 1,800 gal. of 2,000 gal. spill recovered). Product reached	TPH, PAHs VOCs	SVOCs/8270C/SIM VOCs/8260

Site Name and Address	Closest EDR Area	Fig. 3 ID	List(s)	Notes	Potential Contaminants	Relevant Sediment Analyses/EPA Method
Falls, OR				Product reached GW. Hazardous materials include **PCE, benzene, petroleum,** and **VOCs.**		
Timbermill Shores (former Modoc Lumber) 404 S. 4th Street, Klamath Falls, OR	Area 4, orphan		ECSI	Former lumber mill operated under different owners since the early 1900s; contaminants: **PAHs** and **hydraulic oil**. Institutional controls following remediation include no use of shallow GW, no excavations, and no residential or agricultural uses.	TPH, PAHs	SVOCs/8270C/SIM
Ewauna Box Co. (former) 1516 S. 6th Street, Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	Suspect site requiring further investigation; suspected contaminants **TPH, PCBs,** and **dioxins**. Located on the east shore of Lake Ewauna.	TPH PCBs Dioxins	SVOCs/8270C/SIM PCBs/8082 Dioxins/1613
Big Lakes Box Co., 1580 S. 6th Street, Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	Suspect site requiring further investigation; located on shore of Lake Ewauna; suspected contaminants **woodtreating chemicals, pesticides,** and **solvents**.	SVOCs Pesticides VOCs	SVOCs/8270C/SIM Pesticides/8081 VOCs/8260
Prime Equipment,	Area 4, DEQ		ECSI	**Gasoline** and **MTBE** detected	TPH VOCs	SVOCs/8270C/SIM

Site Name and Address	Closest EDR Area	Fig. 3 ID	List(s)	Notes	Potential Contaminants	Relevant Sediment Analyses/EPA Method
3344 Washburn Way, Klamath Falls, OR	Profiler			in GW.		VOCs/8260
PacifiCorp 1950 Mallard Lane, Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	**PCB** capacitor spill on 4/27/88; 2.5 gallons spilled onto gravel surface; gravel, soil and buffer area excavated; soil disposed of in Idaho or Arkansas.	PCBs	PCBs/8082
Klamath Veneer 4605 Lakeport Blvd., Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	**Diesel fuel** spill in 1985 entered Klamath Lake.	TPH	SVOCs/8270C/SIM
Fashion Cleaners (former) 623 Klamath Ave., Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	**PCE** detected in GW and soil (other contam-inants include **TCE, trans-1,2-dichloro-ethylene, 1,1,1-TCA, chloro-form**). Soil removed and GW treated in 1995; 1999 RI/FS concluded that natural attenuation may be sufficient to reduce remaining contaminant concentrations.	VOCs	VOCs/8260
May-Slade Oil Co. 865 and 953 S. Spring Street, Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	Active bulk plant; voluntary cleanup site. Contaminants **TPH** (gasoline, diesel fuel,	TPH VOCs	SVOCs/8270C/SIM VOCs/8260

Site Name and Address	Closest EDR Area	Fig. 3 ID	List(s)	Notes	Potential Contaminants	Relevant Sediment Analyses/EPA Method
OR				heating oils, and lube oils). Large gasoline spill occurred in 1999. Free product on GW and dissolved-phase plume (**benzene**) has migrated off site; shallow GW within 3 feet of ground surface.		
Klamath Falls Street Dept. (former Mew Data Arms [MDA]), 1199 S. Spring Street, Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	MDA formerly discharged spent plating bath solutions to a floor drain that discharged to a ditch. Primary contaminant: **chromium**; **cyanide** and **VOCs** also detected in GW. Contaminated soil excavated in 1991, but cleanup not completed; potential for off-site contamination not addressed.	Metals VOCs	Metals/6010/7471 VOCs/8260
Burlington Northern Santa Fe 1800 Laverne Ave., Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	Widespread petroleum contamination (mainly **bunker fuel and diesel**) identified in 1989, including free product on GW. Soil removal conducted; passive recovery system installed in 1996. GW impacted by	TPH, PAHs VOCs	SVOCs/8270C/SIM VOCs/8260

Site Name and Address	Closest EDR Area	Fig. 3 ID	List(s)	Notes	Potential Contaminants	Relevant Sediment Analyses/EPA Method
				benzene and **PAHs**.		
Clough Oil Company 977 S. Spring Street, Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	Diesel spilled in 1987 when driver overfilled a storage tank; excavated soil and gravel disposed at Klamath County Landfill. Elevated **benzene, gasoline,** and **xylenes** in GW.	TPH VOCs	SVOCs/8270C/SIM VOCs/8260
General Petroleum Corp. (former) 709 S. Riverside Street Klamath Falls, OR	Area 4, DEQ Profiler		ESCI	Added to database for tracking as a former bulk plant (dates back to at least 1931); located near west shore of Lake Ewauna.	TPH Lead	SVOCs/8270C/SIM Lead/6010
Jeld-Wen (and Pelican Bay), 3303 Lakeport Blvd., Klamath Falls, OR	Area 4, DEQ Profiler		ECSI	Sawmills have operated at this complex since 1860. **PCP** spill in 1986 impacted GW. Treatment system operated until 1995, recovered 13,150 gallons of product; signif-icant levels of dissolved PCP still present in GW. USTs removed from Pelican Bay site in 1992; **TPH** and **PCP** found in soil and GW. Risk assessment (2001) indicated unacceptable	TPH Dioxins	SVOCs/8270C/SIM Dioxins/1613

Site Name and Address	Closest EDR Area	Fig. 3 ID	List(s)	Notes	Potential Contaminants	Relevant Sediment Analyses/EPA Method
				risks (**dioxin** and **PCP**). Pilot-scale study on-going since 2001.		

CERC-NFRAP Comprehensive Environmental Response, Compensation, and Liability Act – no further remedial action planned (USEPA)

ECSIEnvironmental Cleanup Site Information System (DEQ)

GW Groundwater

HW GenHazardous Waste Generator (DEQ)

LUSTLeaking UST List (DEQ or SWRCB)

mg/kg milligrams per kilogram

mg/L milligrams per liter

µg/L micrograms per liter

MTBE Methyl tertiary butyl ether

MW Monitoring well

OR HAZMATHazardous materials incidents (Oregon State Fire Marshal's Office)

PAHs Polynuclear aromatic hydrocarbons

PCBs Polychlorinated biphenyls

PCE Tetrachloroethylene (perchloroethylene)

PCP Pentachlorophenol

PRGs USEPA's Preliminary Remediation Goals

PSQG Provincial Sediment Quality Guidelines

RCRA-SQGResource Conservation and Recovery Act – Small Quantity Generator (USEPA)

RI/FSRemedial Investigation/Feasibility Study

SVOCs Semivolatile organic compounds

SIM Selective ion monitoring

TCA Trichloroethane

TCE Trichloroethylene

TP Test pit

TPH Total petroleum hydrocarbons

UST Registered Underground Storage Tank List (DEQ or SWRCB)

VOCs Volatile organic compounds

Copco 1 Sediment Drilling Locations

1 Using digitized bathymetric contours from PacifiCorp maps for both original topography and current bathymetry, calculations of sediment volume indicate that Copco 1 Reservoir contains approximately 11 million cubic yards of sediment.

1 Predam survey was of poor quality. Contours at the upper end of the reservoir are not discernable. The accuracy of quantity estimates and sediment locations is limited by the accuracy of the original survey information.

1 Sediment accumulation appears to be fairly even along the length of the reservoir.

1 Maximum sediment thickness appears to be less than 20 feet. Most locations have sediment depths less than 15 feet.

Table 3 Drilling Location Details for Copco 1 Reservoir

Hole #	Sediment Elevation Feet	Distance from Dam along River Alignment Feet	Sediment Thickness Feet	Water Depth Feet	Anticipated Type of Sediment
1	2592	27000	15	14	Granular
2	2585	23500	10	21	Silt
3	2582	16500	10	24	Sand/Silt
4	2552	14000	10	54	silt/clay
5	2552	9500	7	54	silt/clay
6	2533	8500	10	73	clay
7	2600	29000	20	6	Granular
8	2568	19500	8	38	silt/clay
9	2542	12500	12	64	silt/clay
10	2520	5000	10	86	silt/clay
11	2575	5000	10	31	Sand/Silt

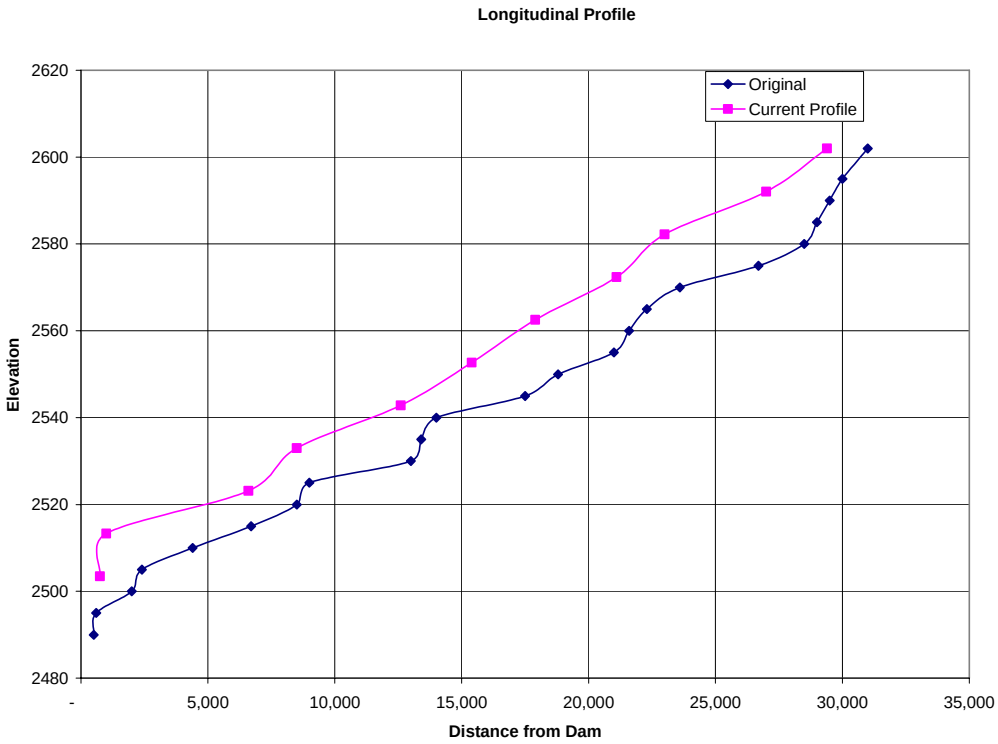


Figure 2 Center Line Profile Copco 1 Reservoir

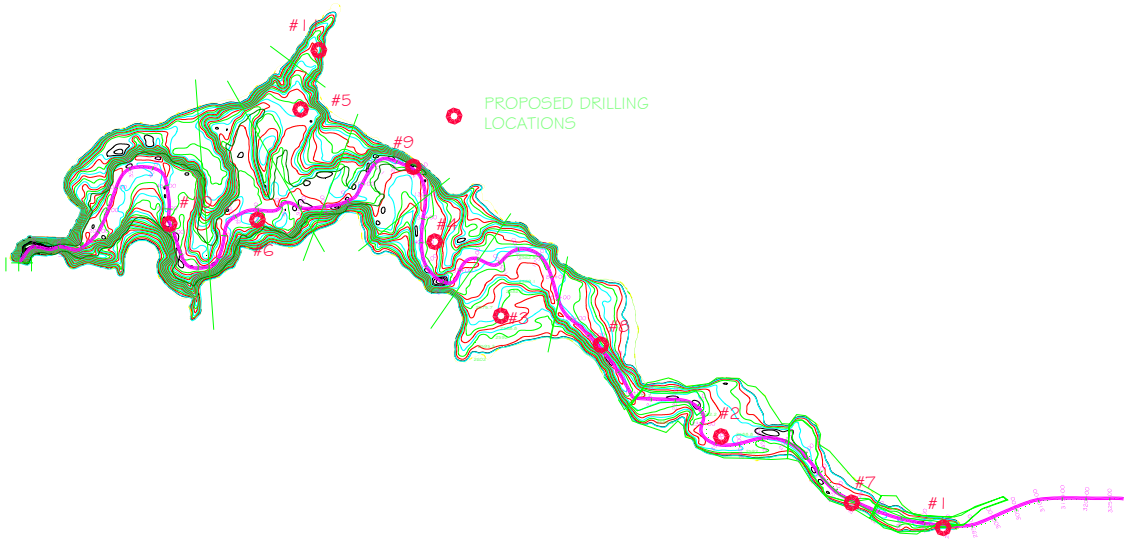


Figure 3 Proposed Drilling Locations - Copco 1 Reservoir

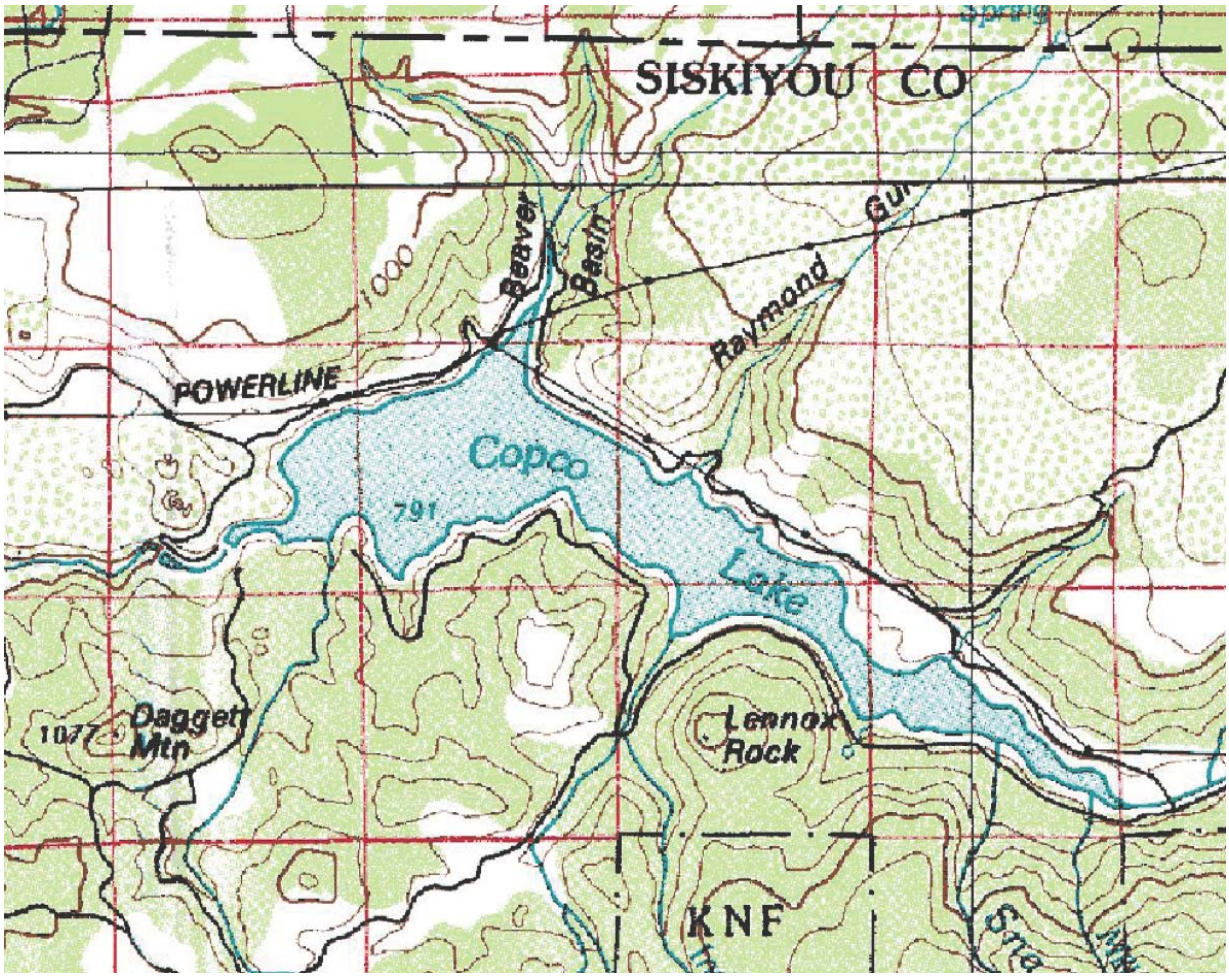


Figure 4 Tributaries to Copco 1 Reservoir

Iron Gate Drilling Locations

1. Using digitized bathymetric contours from PacifiCorp maps for both original topography and current bathymetry, calculations of sediment volume indicate that Iron Gate Reservoir contains approximately 8 million cubic yards of sediment.
2. Virtually no sediment accumulation upstream of 25,000 feet upstream of the dam. (7,600 Meters). This location is just slightly upstream of Jenny Creek
3. Fall Creek meets IG reservoir just upstream of a bridge across the reservoir. There is no apparent sediment deposition at this location, which is about 6 miles upstream of the dam.
4. Sediment appears to be mostly from Jenny Creek.
5. Jenny Creek is the longest tributary to the reservoir and has the largest capture area.
6. The maximum sediment depth is approximately 20 feet.

Table 4 Proposed Drilling Location Details

Hole #	Sediment Elevation Feet	Distance from Dam along River Alignment Feet	Sediment Thickness Feet	Water Depth Feet	Anticipated Type of Sediment
1	2306	21300	15	18	Granular
2	2256	9800	12	68	Silt
3	2217	12000	10	107	Silt
4	2226	4000	2	98	clay
5	2306	9500	2	18	Granular
6	2295	9800	20	29	Granular
7	2246	16500	20	78	silt/clay
8	2197	7000	5	127	silt/clay
9	2276	21000	10	48	silt/clay

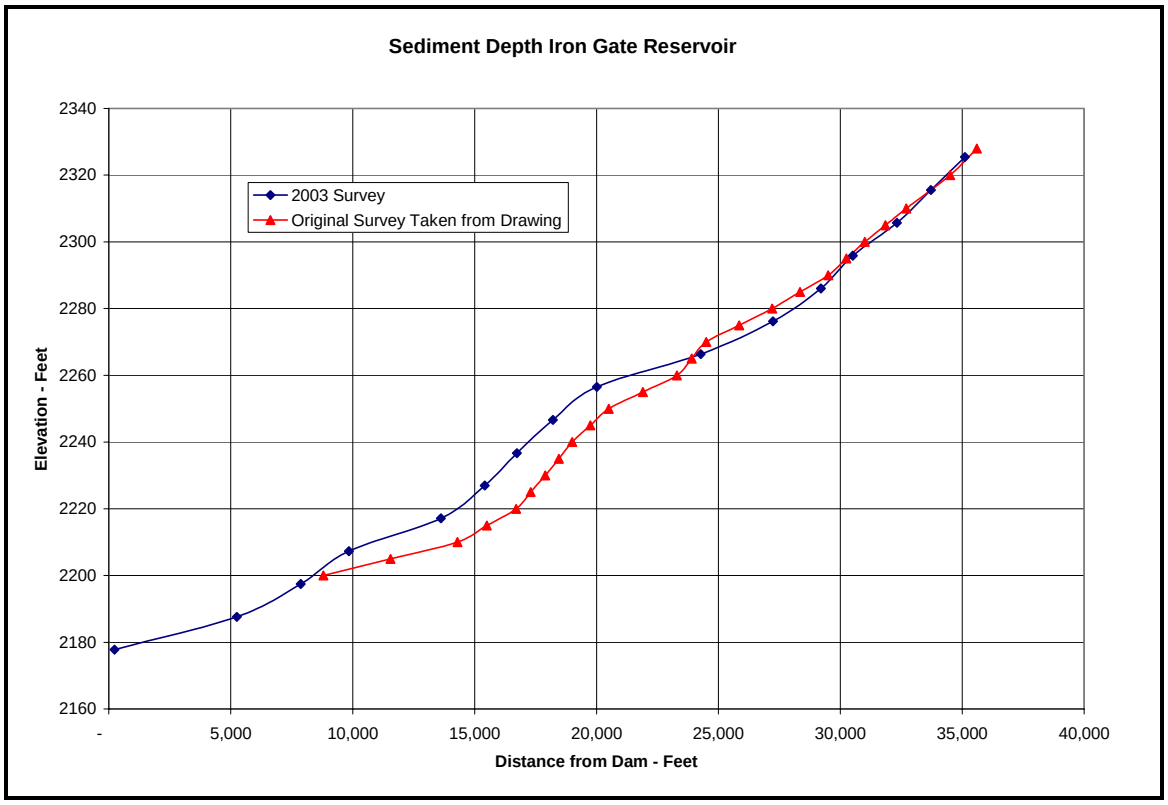


Figure 5 Sediment Depth - Iron Gate Reservoir

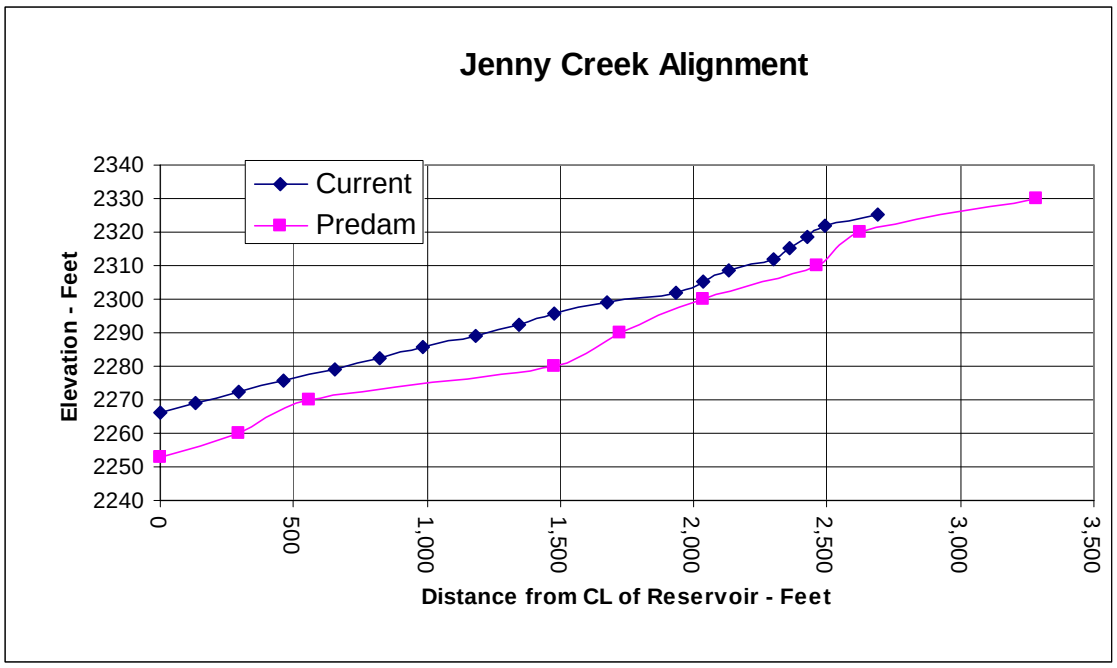


Figure 6 Sediment Depth at Jenny Creek

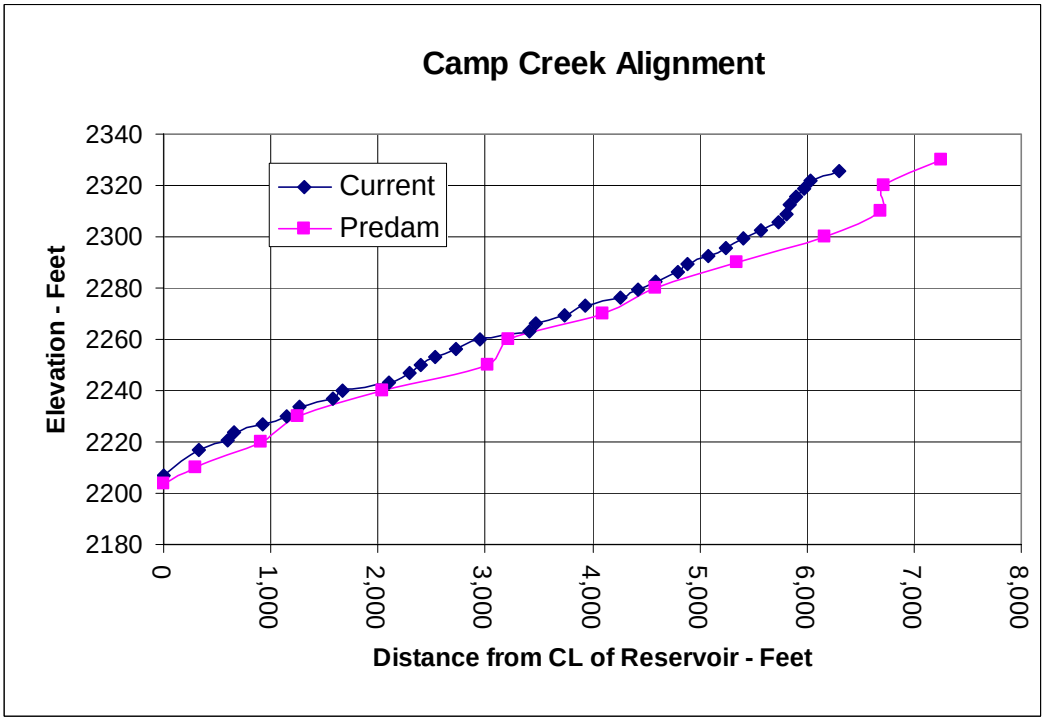
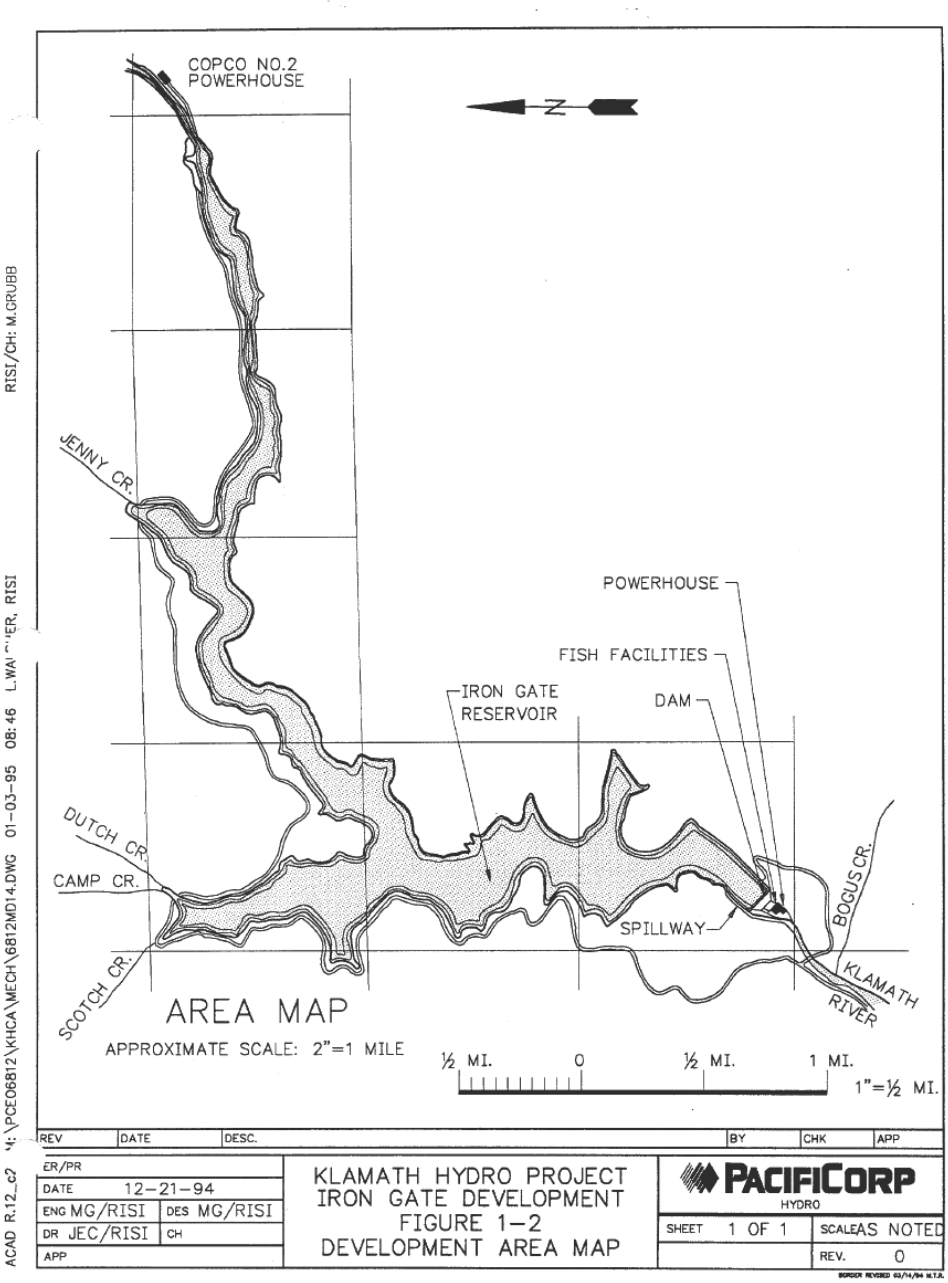


Figure 7 Sediment Depth at Camp Creek

PacifiCorp
Klamath Hydroelectric Project
FERC Project No. 2082



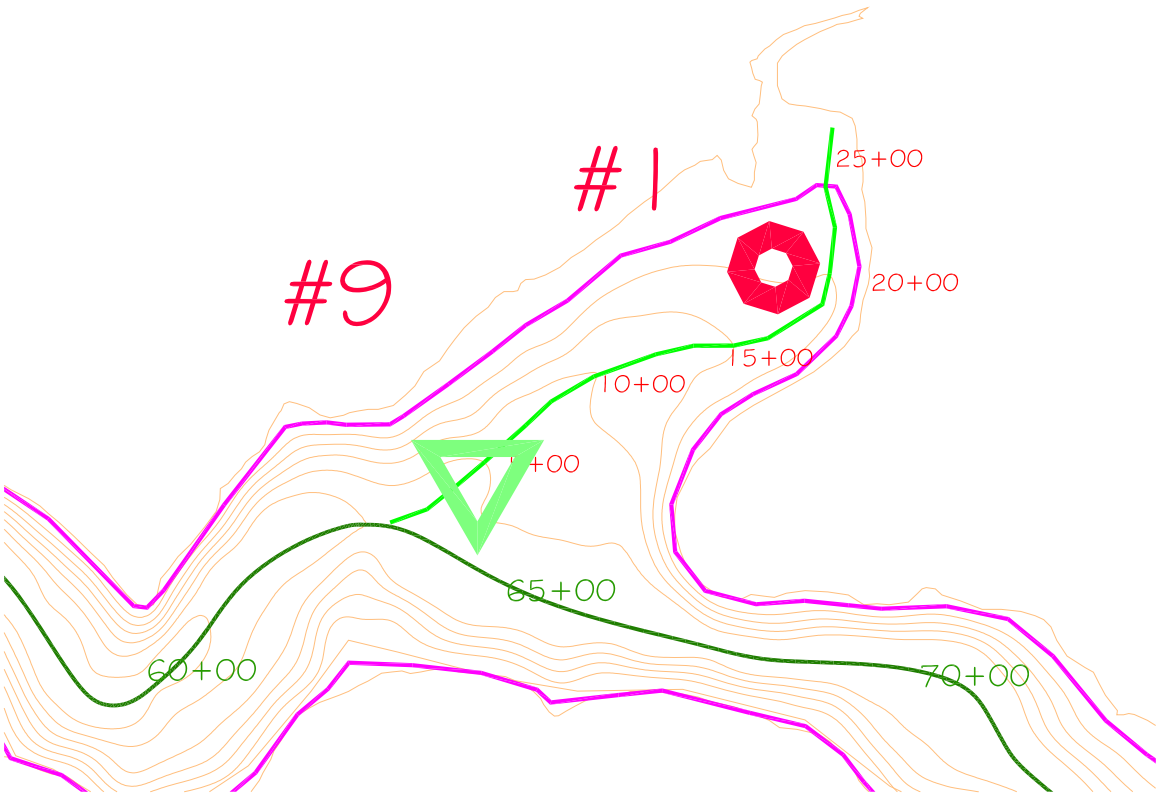


Figure 8 Bathymetry of Jenny Creek in Iron Gate Reservoir

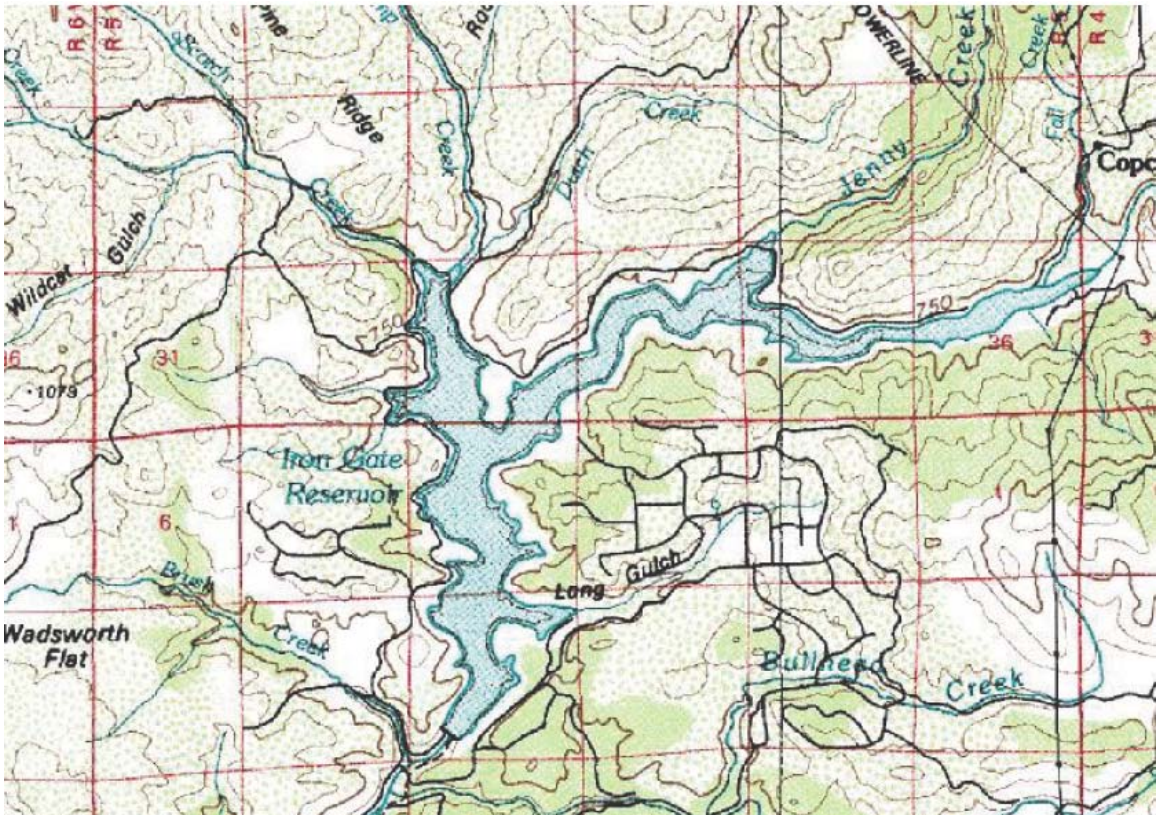


Figure 9 Iron Gate Reservoir and Tributaries

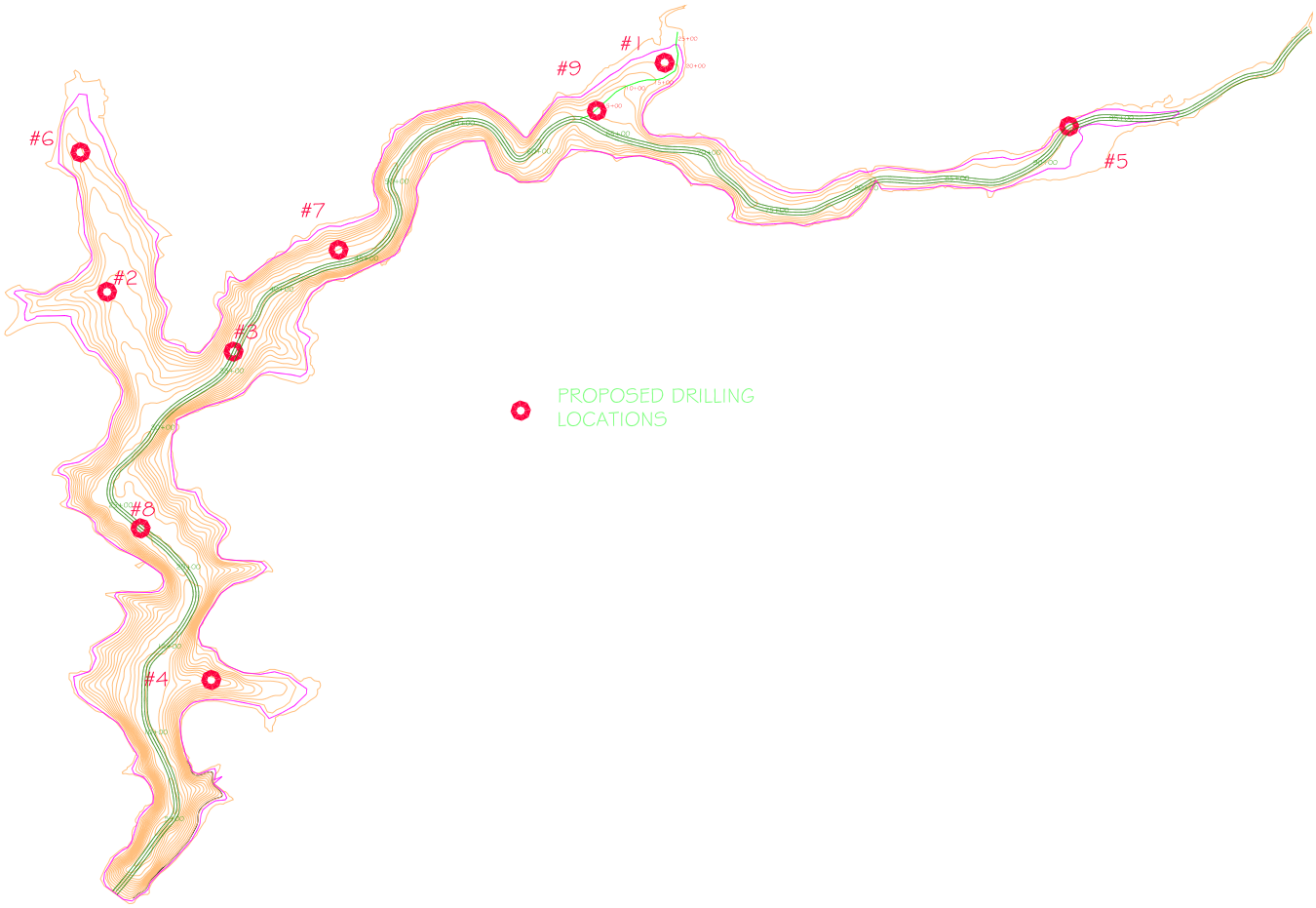


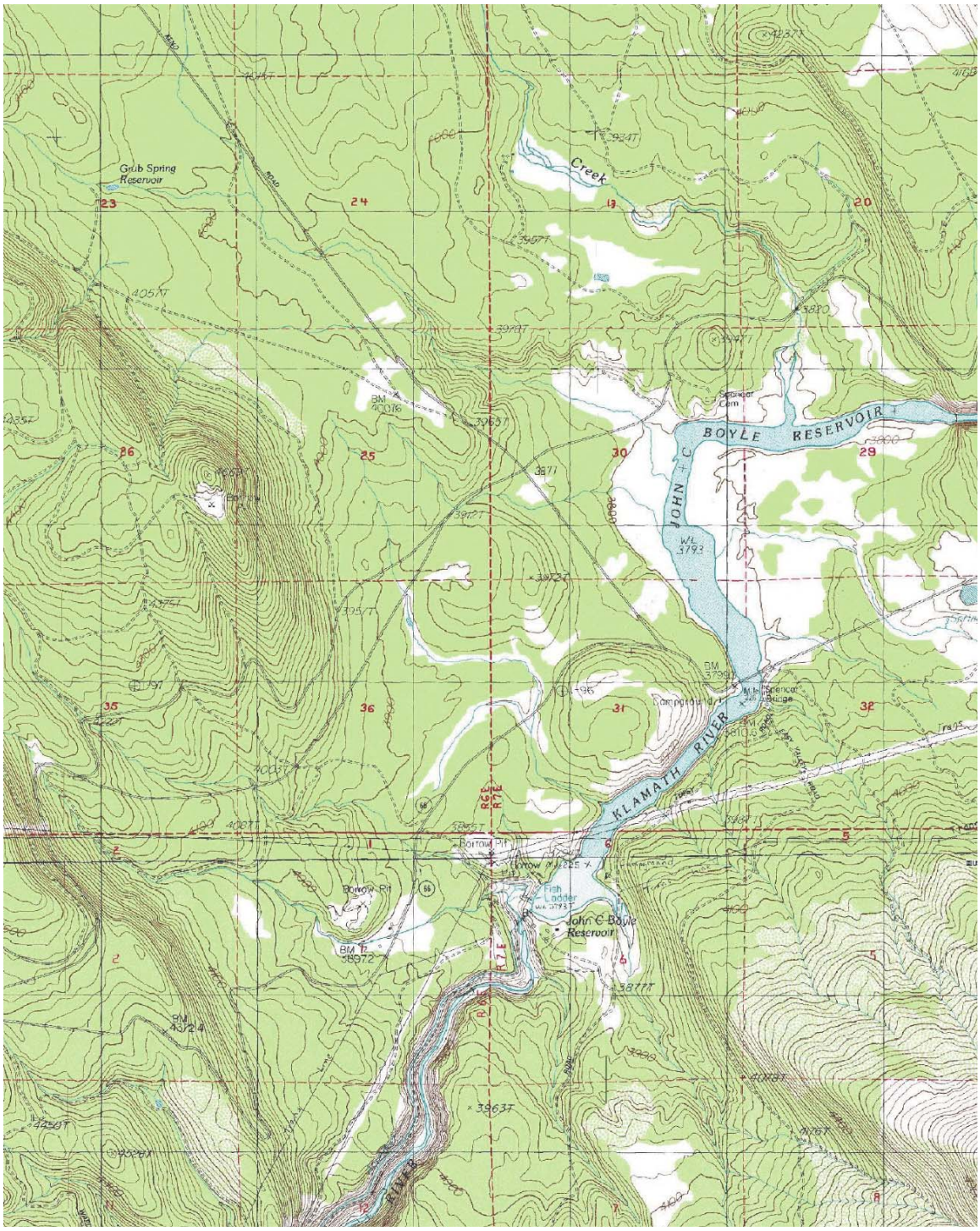
Figure 10 Proposed Drilling Locations

J. C. Boyle Drilling Locations

1. Original J. C. Boyle survey was conducted in 1959 prior to dam construction. The survey shows only water surface elevations. Original survey did not include river bathymetry. The current survey show deep pools in the river at the time of the original survey would have existed. These pools limit the knowledge of original river bathymetry.
2. Dams upstream of J. C. Boyle dam have trapped most of the sediment moving downstream into the reservoir.
3. Using PacfiCorp digitized maps, analysis indicates that approximately 1,000,000 million cubic yards of sediment is trapped in the reservoir.
4. Sediment thickness for most of the reservoir cannot be estimated because the current sediment elevation is below the predam river elevation.
5. Near the dam sediment thickness can be estimated.

Table 5 J. C. Boyle Drilling Location Details

Hole #	Sediment Elevation	Distance form Dam along River Alignment	Sediment Thickness	Water Depth	Anticipated Type of Sediment
1	3755	1000	15	38	Silt/sand
2	3786	14000	2	7	Silt
3	3780	6000	2	13	clay
4	3775	12500	2	18	clay
5	3780	10500	2	13	clay



1.

Figure 11 J. C. Byle Reservoir and Tributaries

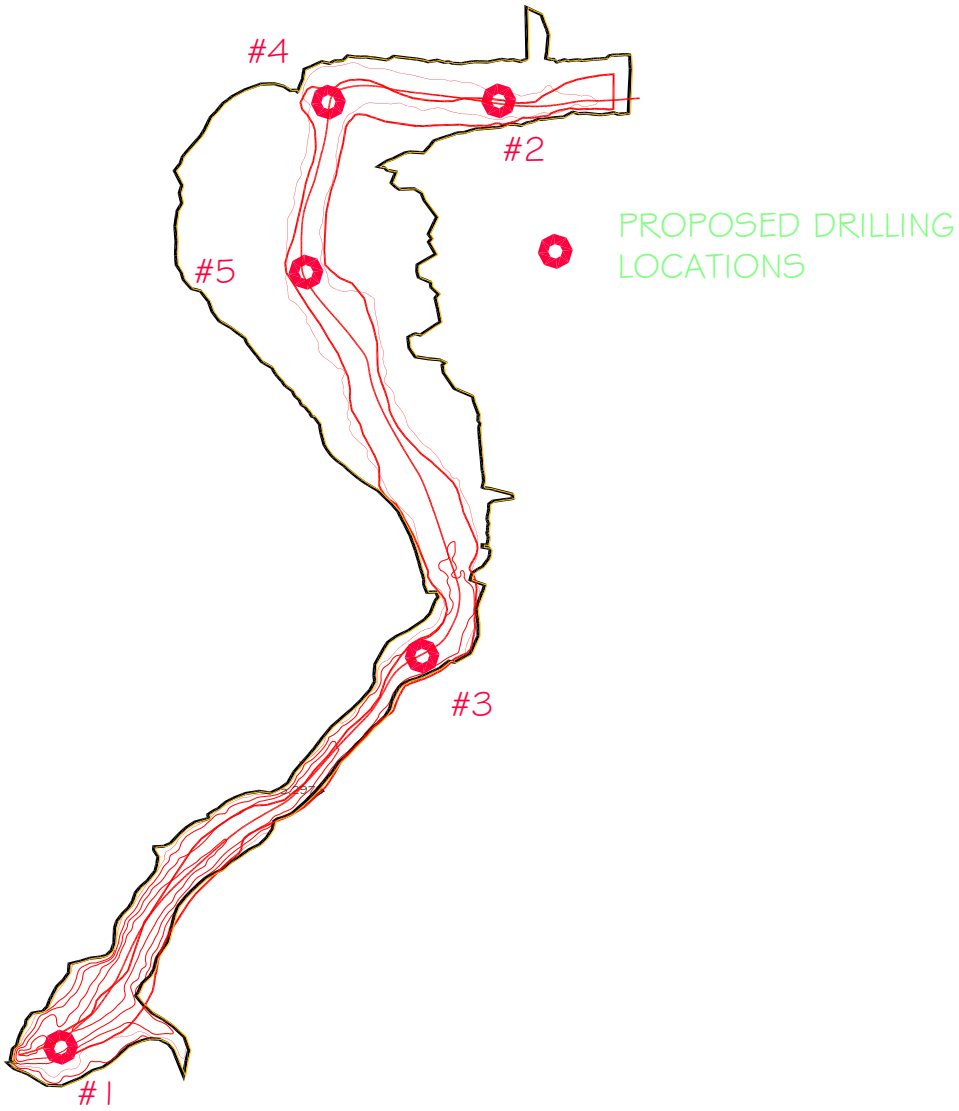


Figure 12 Proposed Drilling Locations in J. C. Boyle Reservoir

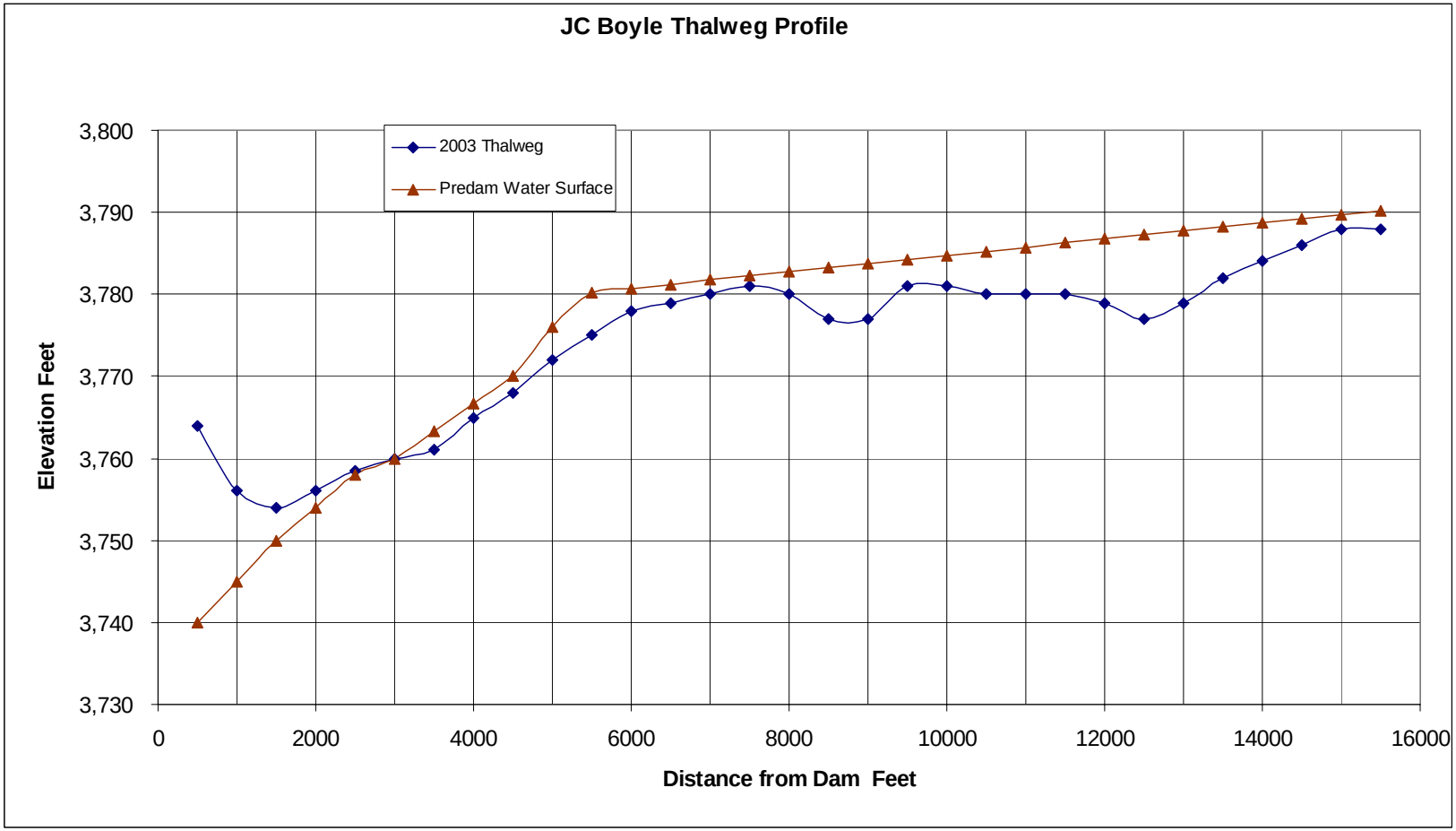


Figure 13 Longitudinal Profile of J. C. Boyle Reservoir